

Patient-Specific Injury Metrics Predict Early Biomarker Response in Multiply Injured Patients

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Introduction: It is important to identify multiply injured patients (MIPs) that can tolerate high-magnitude procedures and those at risk for complications. Determining how injury leads to immunologic dysfunction could identify MIPs at risk for complications. We explored a new precision medicine approach in which we determined how patient-specific injury metrics corresponded to changes in cytokines in a prospective cohort of MIPs.

Methods: This was a prospective observational cohort of 40 MIPs, 18-55 yo, admitted to surgical ICU having had full axial CTs done at admission. Mechanical tissue damage was quantified by calculating volumetric measures of injuries from CT scans into the Tissue Damage Volume score (TDV). Ischemic tissue damage was calculated by calculation of all abnormal Shock Volumes (SV) (heart rate/systolic blood pressure \geq 0.9) in the first 24hr after injury. TIMS was calculated by combining mechanical and ischemic tissue damage: $TIMS = TDV + 5 \times SV$. Linear regression was performed between TIMS and 21 cytokines including interleukin (IL)-6; IL-8; IL-10; IL-1RA; IL-2RA; MCP-1 drawn at 0hr, 8hr, and 24hr after injury. Linear regression was also performed between the cytokines, Injury Severity Score (ISS) and minimum pH (day 1).

Results: Mean and median ISS was 29 (range 9 – 66). Minimum pH demonstrated best correspondence to cytokine levels measured 0hr and 8hr after injury. TIMS demonstrated the best correspondence to cytokine levels 24hr after injury. ISS demonstrated minimal predictive value of cytokines at any timepoint.

Discussion: A precision medicine approach using a patient-specific quantity of injury predicted trauma-associated changes in circulating cytokines at 0hr, 8 hr, and 24 hr after surgery. This corresponds favorably with timing of orthopaedic surgical decisions regarding staged fracture interventions. While clinical significance of these findings is unknown, computational data analyses of temporal cytokine changes have been shown to be predictive of adverse outcomes after injury.